The Victorian Naturalist

Volume 128 (1) February 2011

Published by The Field Naturalists Club of Victoria *since 1884*

From the Editors

Last year, 2010, was an especially productive year for *The Victorian Naturalist*. More than 280 pages were published, comprising 39 substantive papers: 13 Research Reports, 21 Contributions, and five Naturalist Notes. With the advent 2011, we hope that the content of *The Victorian Naturalist* will continue in similar vein, in terms of both quantity and quality.

A significant element in the eventual size of a volume is the number of special issues within the volume. In 2010 there were two issues that focused on particular themes. The highlight was the final issue, which was compiled in memory of an outstanding contributor to the field of marine invertebrates. This was a landmark issue, particularly as papers on marine invertebrates are relatively infrequent in this journal. To have published such a good collection of papers on this subject a rare achievement.

The production of a themed issue brings particular editorial challenges and demands but, at the same time, particular pleasures. Although long-term planning of the journal's content usually does not extend more than a few issues ahead, it is anticipated that at least one special issue will be forthcoming this year. This will consist of papers presented at the FNCV 2010 Biodiversity Symposium, the title of which was 'Melbourne's biodiversity – past and present'.

Once again, the editors welcome readers to what will be another year of interesting and informative papers.

The Victorian Naturalist
is published six times per year by the

Field Naturalists Club of Victoria Inc

Patron: His Excellency, the Governor of Victoria

Registered Office: FNCV, 1 Gardenia Street, Blackburn, Victoria 3130, Australia.
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Membership category		*Institutional*	
Single	$68	Libraries and Institutions	
Concessional (pensioner/Senior)	$52	- within Australia	$120
Family (at same address)	$90	- overseas	AUD130
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The Victorian Naturalist

Volume 128 (1) 2011 February

Editors: Anne Morton, Gary Presland, Maria Gibson

Editorial Assistant: Virgil Hubregtse

ISSN 0042-5184

Front cover: Blue Tiger *Tirumala hamata*. See page 11. Photo by Michael Murphy.
Back cover: Tailed Emperor *Polyura sempronius*. See page 11. Photo by Michael Murphy.

Functional burrow morphology of *Laomedia healyi* (Crustacea: Decapoda: Thalassinidea) in Western Port Bay, Victoria

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Abstract
This study investigated the burrow morphology of the mud shrimp, *Laomedia healyi* Yaldwyn & Wear, in stands of mangrove in Western Port Bay, Victoria. Burrow structure was described from resin casts. *L. healyi* burrows extended further horizontally than vertically and burrows were constructed around the pneumatophores that densely penetrate the sediment at the base of the mangrove trees. Burrows had multiple surface openings, several of which were circular and constricted and others that were oval shaped, connected to a single vertical or sloping main tunnel. The tunnels had a sub-circular cross section with smooth floors and rough walls and roofs and tunnel diameters were considerably larger than the inhabitant. Bulbous terminal chambers were present but did not contain plant material. The characteristic features of *L. healyi* burrows indicate that the species is most likely a deposit feeder. (*The Victorian Naturalist* **128** (1) 2011, 4-10).

Key words: Thalassinidea, Laomediidae, *Laomedia healyi*, burrow morphology

Introduction

Thalassinidean shrimp inhabit marine intertidal and subtidal soft sediment environments and construct burrows that they use for shelter, reproduction and feeding. Burrow morphology is species-specific (Suchanek 1985) and differences in burrow structure have been linked to differences in trophic mode (Griffis and Suchanek 1991; Nickell and Atkinson 1995). A typical burrow of a filter/suspension-feeding species is U-shaped with a circular tunnel cross-sections and a close fit between size of the animal (width of the carapace) and tunnel diameter (Nickell and Atkinson 1995). These features assist filter/suspension feeding by facilitating current generation and efficient flow of water within the burrow (Nickell and Atkinson 1995). A typical burrow of a seagrass/algae-harvesting species has holes without mounds, oblique tunnels which allow access to the sediment surface and deep chambers for storage of plant material (Nickell and Atkinson 1995). A typical burrow of a deposit/detritus-feeding species has surface mounds where processed sediment is ejected, small, circular openings for current generation, and a deep, tightly layered lattice of tunnels and chambers where the species 'mines' the deposit (Nickell and Atkinson 1995). If a deposit-feeding species relies on organic material from the sediment surface, burrow openings and tunnels will be sub-circular as the species 'bulldozes' sediment between the surface and the burrow (Nickell and Atkinson 1995).

Burrow structure also is influenced by the localised sediment environment. Berkenbusch and Rowden (2000) found that the species *Callianassa filholi* constructs deeper, wider burrows in sediments with lower organic content. Thalassinidean burrows constructed in sand generally penetrated further into the sediment than burrows contructed in mud, possibly to retain larger volumes of water and prevent desiccation and hypoxia (Griffis and Chavez 1988). The shape of *Callianassa pontica* burrows was more irregular in fine sand than in coarse sand, where burrows had simple tunnels and enlarged chambers (Griffis and Suchanek 1991). Structural complexity of the sand or mudflat also affects burrow structure, with the burrows of *Nihonotrypaea petalura* found to wind around boulders or cobbles buried in the sediment (Shimoda and Tamaki 2004).

The burrowing ecology of thalassinideans has been well documented on open mudflats (for example, Dworschak and Rodrigues 1997) and in mangrove channels (Dworschak and Ott 1993; Felder 2001), but burrows within stands of mangroves have received little attention. Sediments associated with mangrove trees are

penetrated by subsurface roots and pneumatophores, thereby creating a complex environment to burrow in. Structural characteristics of crab burrows, such as volume and shape, can be influenced by the biomass of underlying mangrove roots and pneumatophores (Lim and Heng 2007; Berti *et al.* 2008; Katrak *et al.* 2008), with some species specifically selecting regions with pneumatophores for burrow construction (Lim and Rosaih 2007). It is likely that thalassinidean burrow structure also would be affected in a similar way.

Laomedia healyi Yaldwyn & Wear(Decapoda: Thalassinidea: Laomediidae) is distributed intertidally along the eastern Australian coast, from northern Queensland through to central Victoria, including Western Port Bay, and occurs most frequently in mangrove habitats (Yaldwyn and Wear 1972; Poore and Griffin 1979). While previous studies have examined the burrow structure and trophic mode of other genera within the family Laomediidae, little is known about the burrow structure of species in the genus *Laomedia*. Casts of *L. astacina* burrows are documented in Ohshima (1967) and Utashiro (1973) and resemble the burrows of the laomediid *Jaxea nocturna*. *Jaxea nocturna* constructs burrows with multiple entrances that link to a gently sloping main tunnel with a sub-circular cross-section (Pervesler and Dworschak 1985; Nickell and Atkinson 1995). *Axianassa australis* is a laomediid that builds more complex burrows with tight corkscrew-like spiral sections (Dworschak and Rodrigues 1997; Felder 2001). The aim of this study was to investigate the structure and function of *L. healyi* burrows.

Methods

Field sites

Western Port Bay is located approximately 50 km south east of Melbourne, Australia (37°45'S, 144°58'E) and is the second largest bay in Victoria (Marsden *et al.* 1979). Approximately 40% of the 680 km^2 bay is intertidal (Bird 1986), with sediment consisting of clay, silt, fine sand and shell beds (Ross 2000). The field sites, Warneet and Hastings, are located on the northern and western coast respectively (Fig. 1). Both field sites are characterised by stands of the mangrove *Avicennia marina* (Forsk.) Vierh. fringed by sand and mudflats.

Burrow morphology

The burrows of *L. healyi* were cast *in situ* using epoxy resin (Huntsman International LLC Araldite Kit K3600). The resin (3:1 ratio of resin to hardener) was mixed on site. Plastic collars were placed around the openings to funnel the resin, which was left to set for 48 hr. Once set, the casts were removed by hand and rinsed. Eight casts were made at Warneet between October and December 2006, and seven casts were made at Hastings in January 2007. All casts were returned to the laboratory for analysis. Once the casts had dried thoroughly, excess sediment was removed with a toothbrush. Dimensions of the casts were measured using a tape measure, calipers and an electronic balance. Surface area of the burrow was estimated by wrapping the cast in a single layer of aluminium foil of known weight per unit area (Atkinson and Nash 1990; Bird and Poore 1999). Volume was estimated by dividing the cast weight by the density of the resin/hardener mixture (1.055 g/cm^3) (Rowden and Jones 1995; Bird and Poore 1999). To estimate the average tunnel width and height for each cast, all sections of tunnel were measured at 5 cm intervals and an average calculated. The carapace width of any individuals trapped within the burrow casts were measured using callipers. Five chambers were sectioned with a circular saw to reveal if chambers were empty or were used to store rubble or vegetation.

Results

Eight complete casts of the burrows of *L. healyi* were recovered during this study and morphometric data for those casts are given in Table 1. The following descriptions of the burrows of *L. healyi* are based on all complete casts and an additional seven incomplete casts from both sites.

Laomedia healyi burrows generally extended further horizontally than they did vertically and burrow depth averaged 28 cm (Table 1). Pneumatophores regularly protruded through the casts, and tunnels were constructed around this plant material (Fig. 2). Burrows consisted of between one and five surface openings connected to a single main tunnel, which generally led deeper into the sediment either vertically or at an oblique angle (Table 1; Fig. 2). Surface shafts and openings were rarely cast well, but

Fig. 1. Map of Western Port bay, south-eastern Australia, showing the location of the field sites, Warneet and Hastings.

two types of surface openings were identified during collection of *L. healyi* for an associated study. Individuals were collected using a bait pump from small, round holes (approximately 5 mm diameter) and larger oval surface openings (approximately 8 mm diameter). The tunnels had a sub-circular cross section and whilst the floors were relatively smooth, the walls and roofs were rough (Fig. 2). Bulbous chambers often were found at the end of the main tunnel (Fig. 2) but did not contain plant material. This species shows a poor animal: burrow fit, with an average ratio of 1:2.3 (shrimp carapace width: tunnel width) calculated from the individuals found embedded in the resin.

Discussion

Laomedia healyi burrows extended greater horizontally than vertically and burrows were constructed around pneumatophores that densely penetrate the sediment at the base of the mangrove trees. Burrows were most similar to those reported for the laomediid *Jaxea nocturna* (Pervesler and Dworschak 1985) and there was no evidence of the tight spirals observed in the burrows of *Axianassa australis* (Dworshak and Rodrigues 1997).

In Western Port Bay, the root system of *Avicennia marina* mangrove trees comprises 62% of the plant's biomass (Clough and Attiwill 1982) so the sediments surrounding the mangrove trees contain densely-spaced pneumatophores and a fibrous root mat. Burrows of *L. healyi* were constructed around the pneumatophores and roots influencing the overall shape of the burrow. A burrow inhabited by both *Sesarma messa* and *Alpheus* cf. *macklay* cast in a *Rhizophora* spp. mangrove forest was closely associated with mangrove roots in a similar fashion (Stieglitz *et al.* 2000). Other types of physical structure in habitats are known to affect crustacean burrows. The burrows of *Nihonotrypaea petalura* were wrapped around boulders and cobbles and the species could not maintain burrow integrity without them (Shimoda and Tamaki 2004). Mangrove roots do not appear to be a critical factor in structuring burrows of *L. healyi* because the species also is found in open mudflat environments (Ngoc-Ho 1997). This could be confirmed by a comparison between burrows of *L. healyi* in mangroves and on the open mudflat. Shimoda and Tamaki (2004) suggested that habitat complexity on boulder/cobble beaches offered *N. petalura* protection from predators such as wading birds. The habitat complexity in the mangrove environment could offer similar protection for *L. healyi*.

Laterally extensive burrows allow the inhabitant to readily access surface-derived food sources, such as plant material or particulate organic matter (Suchanek 1985). It is most likely that *L. healyi* would be collecting particulate organic matter rather than plant material because terminal chambers showed no storage of plants. Numerous burrow openings at the surface would increase the success of catching this valuable food source (Nickell and Atkinson 1995). Oblique tunnels and sub-circular tunnel cross-sections are also features indicative of surface access (Nickell and Atkinson 1995), although sub-circular tunnels could also result from sediment processing. Nickell and Atkinson (1995) suggested that the subcircular cross-section of tunnels combined with sloping floors results from continual activity: walking, feeding and bulldozing. *Jaxea nocturna* was observed to bulldoze sediment around its burrow and out the burrow entrance at night. This

Table 1. Dimensions of selected casts of burrows of *Laomedia healyi* collected from Warneet and Hastings.

Site	Cast no.	No. of openings	Depth (cm)	Horizontal extension (cm)	Mean width (mm)	Tunnel height (mm)	Surface area (cm^2)	Volume (cm^3)
Warneet	W1	3	45	23	22	17	1617	308
	W2	4	30	22	19	16	1438	267
	W3	3	18	44	29	21	2500	657
	W4	1	34	16	25	15	1192	235
	W5	5	14	29	24	16	950	290
Hastings	H1	4	21	30	13	10	838	229
	H2	3	39	41	29	23	1854	800
	H3	4	23	21	24	18	1000	387
	Mean± SD	3 ± 1	28 ± 11	28 ± 10	23 ± 5	17 ± 4	1423 ± 558	397 ± 214

bulldozing action created the crenate shaped burrow openings as sediment was pushed out of the burrow (Nickell and Atkinson 1995). Oval shaped openings were observed in *L. healyi* burrow entrances, so similar behaviour would be expected by this species. The burrows of *A. australis* also have a sub-circular cross-section and sloping floors, and marks on the burrow floor are consistent with bulldozing (Dworshak and Rodrigues 1997). Similar to *J. nocturna* and *A. australis*, *L. healyi* had a poor animal-to-burrow fit, which is further evidence of bulldozing behaviour and deposit feeding habit (Dworschak and Rodrigues 1997). A circular tunnel cross-section and tight animal-to-burrow fit (both features of filter-feeding thalassinidean burrows and not present in *L. healyi* burrows) facilitates efficient current generation and water flow through the burrow (Nickell and Atkinson 1995).

The majority of surface openings of *L. healyi* were constricted. The major function of a constricted burrow opening is to accelerate the current of water being ejected from the burrow thereby improving burrow water circulation (Bromley 1990). It has been suggested that constricted surface openings of thalassinidean burrows can be enlarged at times to allow surface access for collection of organic-rich surface sediment (Kinoshita and Itani 2005). It is known that *J. nocturna* moves onto the surface at night to collect material from the sediment surface (Nickell and Atkinson 1995). Behavioural observations of *L. healyi* in aquaria or in the field are needed to examine when the species accesses the surface and what activities take place.

Sediment is processed by thalassinideans when collecting food or when burrows are expanded or repaired (Griffis and Suchanek 1991). The presence of chambers in the burrows of *L. healyi* is also indicative of sediment processing by the shrimp, and are used by some species to store either coarse material, such as rubble or plant material, as a food source (Griffis and Suchanek 1991). A combination of surface access, sediment processing and storage burrow features in *L. healyi* burrows indicate that food sources probably include surface or subsurface sediment or organic material on the sediment surface (Nickell and Atkinson 1995). No plant material was found stored in chambers and no evidence of plant matter was found in the gut contents, therefore it is unlikely that this species collects food such as drift algae or seagrass from burrow openings to eat directly or store in chambers to facilitate microbial growth (Abed-Navandi *et al.* 2005). Chambers in *L. healyi* burrows had rough walls and floors (unlike the compacted floors of other parts of the burrows) which may indicate that these regions may have been excavated for deposit feeding.

The burrows of *L. healyi* cast in this study were similar in depth to burrows of other deposit-feeding thalassinideans inhabiting Western Port Bay (*Biffarius arenosus* and *Trypaea australiensis*, Bird and Poore 1999, Stapleton *et al.* 2001) but shallower than has been reported for other species within the family Laomedii-

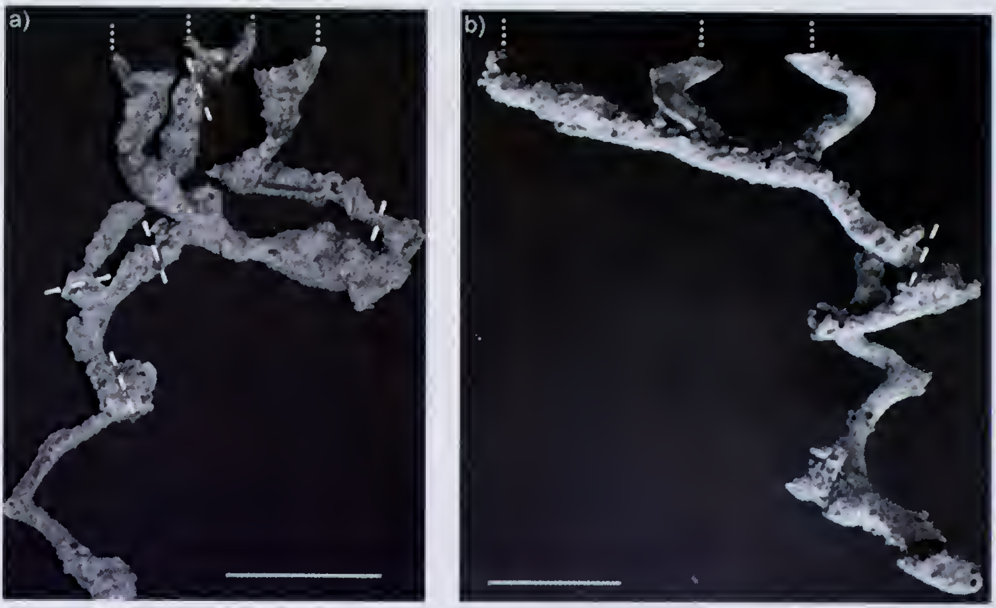

Fig. 2. Casts of *Laomedia healyi* burrows from Western Port: a) Cast W2 and b) Cast H2. Scale bar represents 10 cm. The dotted line represents the extension of the burrow to the surface. The dashed line represents the location of mangrove root material.

dae. Casts of *J. nocturna* have been found to extend to a depth of 80–90 cm (Pervesler and Dworshak 1985; Nickell and Atkinson 1995), and *A. australis* burrows have been shown to reach depths of 130 cm (Dworschak and Rodrigues 1997). The sediments associated with stands of mangroves are in a permanent hypoxic or even anoxic state (Hogarth 1999). It has been argued that U-shaped thalassinidean burrows are flushed well but the complex burrows of deposit-feeding species restrict flushing, resulting in severe hypoxia (Astall *et al.* 1997); however, in mangrove stands, the surface water slope of the incoming tide facilitates flushing in multi-holed burrows (Stieglitz *et al.* 2000). A burrow shared by *Sesarma messa* and *Alpheus* cf *macklay* was fully flushed by passive irrigation with the incoming tide (Stieglitz *et al.* 2000). This flushing would occur to some extent in *L. healyi* burrows, ameliorating the severity of the anoxic conditions. *Jaxea nocturna* has a high sulphide tolerance and burrows to a depth of 92 cm (Johns *et al.* 1997). *Axianassa australis* also burrows to a depth of 130 cm and it has been suggested that the species burrows into the deep hypoxic zone (Felder 2001). Burrows of *L. healyi* are shallower, so this species may have a lower tolerance to anoxia and sulphide than *J. nocturna*. Shallower burrows with well connected tunnels also would flush more thoroughly during a tidal influx.

In conclusion, analysis of burrow structure indicates that *L. healyi* is most likely a deposit feeder that collects organic matter from above and below the sediment surface. Further investigation into diurnal behavioural patterns will reveal if the species ventures onto the sediment surface at night (similar to *Jaxea nocturna*). A comparison of *L. healyi* burrows constructed on the open mudflat and beneath mangrove trees will reveal the extent to which the presence of subsurface mangrove roots affects burrow structure.

Acknowledgements

We would like to thank Sarah Butler for her insight and helpful discussions, and Fiona Bromley, Sharon Frawley, Anna Lister, Kathryn Malempre, Margaret Eagles, Meagan Relf and Rebecca Ryan for field assistance. Funding was provided by the Department of Zoology, La Trobe University. This research was approved by the Department of Primary Industries with a general research project permit (permit number RP 557).

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Received 20 May 2010; accepted 9 December 2010

One Hundred Years Ago

A CYCLE TRIP THROUGH EAST GIPPSLAND

By H. B. WILLIAMSON

(Read before the Field Naturalists' Club of Victoria, 12th June, 1911.)

DURING the recent Christmas holidays I took the opportunity of visiting East Gippsland, the Lakes district, and the vicinity of the Snowy River. I wanted to see, in their native habitat, the plants I had become familiar with by means.of either dried or freshly-picked specimens sent to me by collectors at Orbost—Messrs. J. Rowe, E. Pescott, and C. H. Grove. I also wished to get a knowledge of the birds of Gippsland.

Leaving Melbourne by early train on Thursday, 29th December last, I arrived at Bairnsdale early in the afternoon. Cycling to Swan Reach, on the Tambo River, 13 miles distant, I found the road good, but uninteresting from a botanist's point of view. On the roadside near Bairnsdale I gathered the Crabgrass, *Eleusine cruciata,* and, in a flooded depression, *Damasonium australe:* Just as I arrived at Swan Reach a little river Steamer was coming down from Mossiface. The bridge was "up", and I was just in time to get a picture showing the steamer passing under the bridge, which had been lifted in two parts by hydraulic pressure. I have seen no prettier river than the Tambo, and I advise anyone who has time when at Bairnsdale to make the trip up to Mossiface.

I made Nowa Nowa for breakfast next morning, getting a lift in a waggonette whose driver wanted company. I could have driven all the way to Orbost with him, but preferred staying to look around till dinner-time. A stream, misnamed Boggy Creek, here flows into an arm of Lake Tyers, which winds up from the beach near Cunninghame. … I spent the morning noting the vegetation. It was too late for many of the plants, but nice blooms of *Tristania laurina* and *Trachymene Billardieri* were obtained. *Prostanthera hirtula* also was common, but going off bloom. I collected on the high banks the Oat-grass, *Anisopogoh avenaceus*—a tall, coarse species that I had not met with before. The specimens of Kangaroo-grass, *Anthistiria ciliata,* and *Agrostis rudis,* associated with the Oat-grass, were very fine. Some tall shrubs of *Leptospermum attenuatum* grow just behind the hotel, but fruit only was to be found on them. I feel sure the vicinity of this creek during the month of November would yield a fine "bag" to the collector.

From *The Victorian Naturalist* **XXVIII**, p. 69, August, 1911

Notes on the butterflies of Bruxner Park on the north coast of New South Wales, Australia

Michael J Murphy

'Blackbird Grange', 2 Rundle Street, Coonabarabran, NSW 2357

Abstract

The NSW north coast has a rich butterfly fauna, reflecting its location in the overlap zone between Torresian and Bassian fauna assemblages. This short paper documents observations on the butterflies of Bruxner Park, a small conservation reserve near Coffs Harbour on the NSW north coast, recording 31 species from five families and describing a butterfly hill-topping site at Korora Lookout in the south-east of the reserve. (*The Victorian Naturalist* **128**(1) 2011, 11-17).

Keywords: butterflies, Torresian-Bassian overlap, rainforest, hill-topping

Introduction

Although not particularly rich by global standards, Australia does have an interesting butterfly (Lepidoptera) fauna with a significant number of endemic species. The majority of Australian butterfly species occurs in the tropics, particularly north Queensland (Fisher 1999). The north coast of New South Wales (NSW) also has a notably high diversity of butterfly species, due to its location in the overlap zone between Torresian (northern) and Bassian (south-eastern) fauna assemblages (Braby 2004). This short paper documents observations of the butterfly fauna of a small conservation reserve on the NSW north coast to help promote an appreciation of the region's rich butterfly fauna and to document a site used for hill-topping (i.e. congregation for mating) by a suite of butterfly species.

Study Area and Methods

Bruxner Park Flora Reserve (30°15'S, 153°06'E) is a 407 ha conservation reserve near Coffs Harbour, in *Gumbaynggirr* Aboriginal Country in the NSW north coast bioregion. The reserve has a steep to undulating terrain and an underlying geology of metamorphosed shale. The vegetation is dominated by subtropical rainforest and moist eucalypt forest. Small areas of dry eucalypt forest with a grassy understorey (totalling about 10 ha) occur on north-facing upper slopes and ridge tops in the south-east of the reserve, overlooking the coastal plain.

Observations of butterflies were noted on a total of 40 days (nine days in spring, seven in summer, 20 in autumn and four in winter) over the period March 2002 to February 2003 and January 2004 to January 2005. Many of the observations were made incidentally during the course of a field survey of the vertebrate fauna of Bruxner Park (Murphy and Murphy in press) but also included nine days in March–April 2002, one day in September 2002, nine days in January–May 2004 and two days in October 2004 when butterflies were a primary target for observation. Adult butterflies were observed by day while walking along road edges, vehicle trails and walking trails. The full range of vegetation communities present was investigated, with particular attention paid to ridge top areas potentially frequented by hill-topping butterflies.

Results and Discussion

Two hundred and one records of butterflies were documented in Bruxner Park comprising 29 species from five families. A list of the species recorded is provided in Table 1, together with information on number of records, seasonal patterns and vegetation communities used. The most commonly recorded species were the Blue Triangle, No-Brand Grass Yellow and Glasswing (see Table 1 for scientific names).

Approximately 130 species of butterfly have broad scale distribution maps that include the Coffs Harbour area (Braby 2000). While some of these may not have suitable habitat available in the local area, and others rely on habitats such as mangrove, swamp forest and coastal

Table 1. Butterflies of Bruxner Park Flora Reserve. Records = number of times species noted, not number of individuals seen. Vegetation community: D = dry eucalypt forest, M = Moist eucalypt forest, R =rainforest. KL = recorded at Korora Lookout: records shown in bold are known hill-topping species (Braby 2000; Britton and Ginn 2008).

Family	Species	Records	Season	Veg. community	KL
Hesperiidae - Skippers	Regent Skipper *Euschemon rafflesia*	1	summer	M	
	Bronze Flat *Netrocoryne repanda*	1	summer	D	**X**
	Ornate Ochre *Trapezites genevieveae*	(Braby 2000)	-	-	
	Southern Silver Ochre *Trapezites praxedes*	(Sibatani 1970)	summer and autumn	R	
	Grass-dart sp. *Ocybadistes* sp./*Suniana* sp	5	autumn	M	
Papilionidae - Swallowtails	Fourbar Swordtail *Protographium leosthenes*	2	summer	DM	**X**
	Macleay's Swallowtail *Graphium macleayanus*	10	autumn and spring	DMR	**X**
	Blue Triangle *Graphium sarpedon*	19	summer, autumn and spring	DMR	**X**
	Orchard Swallowtail *Papilio aegeus*	6	summer, autumn and spring	DMR	X
	Dainty Swallowtail *Papilio anactus*	4	summer and autumn	D	**X**
	Chequered Swallowtail *Papilio demoleus*	2	spring	D	X
Pieridae – Whites & Yellows	Lemon Migrant *Catopsilia pomona*	5	summer	DM	X
	No-Brand Grass Yellow *Eurema brigitta*	21	all seasons with peak in autumn	D	X
	Large Grass Yellow *Eurema hecabe*	10	autumn	D	**X**
	Black Jezebel *Delias nigrina*	13	all seasons	DMR	**X**
	Yellow Albatross *Appias paulina*	1	autumn	M	
	Pearl-white sp. *Elodina* sp.	2	autumn and spring	DM	X
Nymphalidae - Nymphs	Evening Brown *Melanitis leda*	3	autumn and winter	DMR	
	Brown Ringlet *Hypocysta metirius*	12	autumn and spring	MR	
	Varied Sword-grass Brown *Tisiphone abeona morrisi*	1	autumn	D	**X**
	Wonder Brown *Heteronympha mirifica*	5	autumn	MR	
	Common Brown *Heteronympha merope*	1	autumn	M	**X**
	Tailed Emperor *Polyura sempronius*	3	summer and autumn	DM	**X**
	Glasswing *Acraea andromacha*	22	summer, autumn and spring	D	**X**
	Meadow Argus *Junonia villida*	11	autumn and winter	D	X
	Australian Painted Lady *Vanessa kershawi*	5	summer, autumn and spring	DM	X
	Yellow Admiral *Vanessa itea*	1	autumn	D	
	Monarch *Danaus plexippus*	12	summer, autumn and spring	DM	X
	Blue Tiger *Tirumala hamata*	10	summer, autumn and spring	DMR	X
Lycaenidae - Blues	Hairy Line-blue *Erysichton lineata*	3	summer and autumn	DM	X
	Common Grass-blue *Zizina labradus*	10	summer and autumn	D	X

heath not present in Bruxner Park, it is likely that more butterfly species would be identified in Bruxner Park by further survey effort. Several additional species were seen but not identified in the present study and it is probable that the skippers (Hesperiidae) and blues (Lycaenidae) in particular are under-represented in the list of species provided. Records of two additional skipper species, the Southern Silver Ochre *Trapezites praxedes* and Ornate Ochre *Trapezites genevieveae*, from Bruxner Park were noted by Sibatani (1970) and Braby (2000) respectively

and have been included in Table 1. The Australian Museum has specimen records of 25 butterfly species from the Coffs Harbour area (D. Britton, Australian Museum pers. comm. November 2010), including 12 species additional to the present study, with suitable potential habitat available in Bruxner Park, such as the Eastern Dusk-flat *Chaetocneme beata* and Splendid Ochre *Trapezites symmomus* (Hesperiidae), Common Pencil-blue *Candalides absimilis* (Lycaenidae) and Danaid Eggfly *Hypolimnas misippus* (Nymphalidae). Twenty-one species observed during the present study are additional to the Australian Museum records for the Coffs Harbour area.

The documented butterfly fauna of Bruxner Park comprises a mix of Torresian and Bassian species, typical of the NSW north coast. Species with a Torresian distribution include the Regent Skipper, Fourbar Swordtail, Large Grass Yellow, Glasswing and Blue Tiger. Bassian species include the Varied Sword-grass Brown, Wonder Brown, Common Brown and Yellow Admiral. The national status of the species identified was assessed as 'common to very common and widespread' by Braby (2004) except for eight species (Regent Skipper, Bronze Flat, Fourbar Swordtail, Black Jezebel, Varied Sword-grass Brown, Wonder Brown, Monarch and Hairy Line-Blue) listed as 'common but local', one species (Tailed Emperor) listed as 'uncommon but widespread' and two species (Southern Silver Ochre and Ornate Ochre) listed as 'uncommon to rare and local'.

Some of the interesting butterflies found in Bruxner Park are illustrated. Information on general biology is from Braby (2000). The Bronze Flat (Fig. 1), an Australian endemic, is generally active only in the morning and males establish hill-top territories while perching on shrubs close to the ground. It was recorded only once in Bruxner Park, when it was found to be common on a hill-top in dry open forest on a sunny summer morning. The Black Jezebel (Fig. 2) is another Australian endemic. The larvae feed on a variety of mistletoes and adults are typically active high in the canopy, retreating to the shade when it is hot. They were frequently seen flying amongst the treetops in moist and dry eucalypt forest at Bruxner Park, and the animal pictured was found resting within two metres of the ground in rainforest. The Evening Brown (Fig. 3) occurs from Africa, India and south-east Asia to northern Australia and the

Fig. 1. Bronze Flat *Netrocoryne repanda*.

Fig. 2. Black Jezebel *Delias nigrina*.

Fig. 3. Evening Brown *Melanitis leda*.

west Pacific. It is active at dawn and dusk, and during the day was found resting quietly on the ground in rainforest, where its cryptic colouration blended in with the leaf litter. The Brown Ringlet (Fig. 4), endemic to eastern Australia, was typically seen basking with wings open in sunlit patches of long grass on roadsides in tall open forest and rainforest. The Wonder Brown (Fig. 5), endemic to coastal south-eastern Australia, is restricted to rainforest and adjacent tall open forest. The dark-coloured females (pictured) tend to remain in shady gullies while the paler males move into more sunlit open areas. The Common Brown (Fig. 6) is endemic to south-eastern and south-western Australia. It was recorded only once in Bruxner Park, when the female pictured was found sunning on the ground on a hill-top on an autumn morning. The Tailed Emperor (back cover) is a large, fast-flying butterfly with the lower wing surfaces intricately patterned. It is found in the Torres Strait islands, northern and eastern Australia and Lord Howe Island. It was recorded several times at Bruxner Park at the one hill-top site, flying back and forth and perching high in the canopy. The Glasswing (Fig. 7), named for the transparent forewings, occurs in Indonesia,

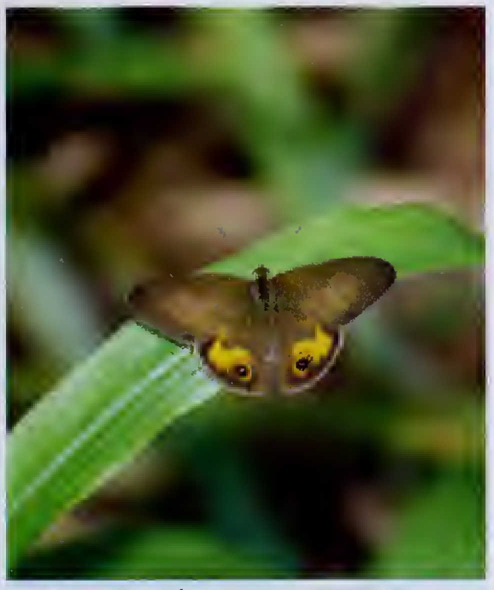

Fig. 4. Brown Ringlet *Hypocysta metirius.*

New Guinea, northern Australia and the west Pacific. It has a slow fluttery flight close to the ground and was regularly observed in hill-top grassy dry forest at Bruxner Park. The Blue Tiger (front cover) ranges from south-east Asia and New Guinea to northern Australia and the west Pacific. It breeds in vine thickets and littoral rainforest in northern Australia and regularly migrates further south. It was usually scarce in Bruxner Park with occasional irruptions of high numbers in summer.

Relatively few species (8 out of 29) were recorded in rainforest in Bruxner Park. The closed canopy of the rainforest was inaccessible and opportunities for observation were restricted to the shaded ground layer and to road edges. A few species such as the Evening Brown and Wonder Brown were seen in the shaded rainforest interior and additional species including the Macleay's Swallowtail, Blue Triangle, Brown Ringlet and Blue Tiger were occasionally seen on sun-lit roadsides, particularly areas with Lantana *Lantana camara.* It is likely that the upper surface of the rainforest canopy supports a rich butterfly fauna.

Ridge tops in Bruxner Park were targeted for butterfly observations in this study, and a total of 25 species (86% of the total) was recorded there. The open canopy of the ridge top eucalypt forest facilitated observation of butterflies moving through the canopy as well as providing natural sunlit patches at ground level which were utilised by butterflies. High points in the landscape may also be used by butterflies congregating for mating (Baughman and Murphy 1988; Guy *et al.* 2004; Murphy 2008) and observations during this study indicated that some of the ridge tops in Bruxner Park were used as hill-topping sites. The most notable butterfly hill-topping site recorded was at Korora Lookout (30°15'53"S, 153°06'59"E), in the south-east of Bruxner Park. Korora Lookout (280 m AHD) is a prominent localised easterly thrusting of the sub-coastal escarpment, standing about 250 m above the adjacent narrow coastal plain, and has dry eucalypt forest with a grassy understorey on the north-facing slope and moist eucalypt forest with an understorey of shrubs on the south-facing slope. Twenty two butterfly species were recorded there (Table 1), of which 50% (11 species) are known hill-topping species (Braby 2000; Britton and Ginn 2008). The maximum number of butterfly species recorded at Korora Lookout at one time was 13 species (in April 2004). Hill-topping behav-

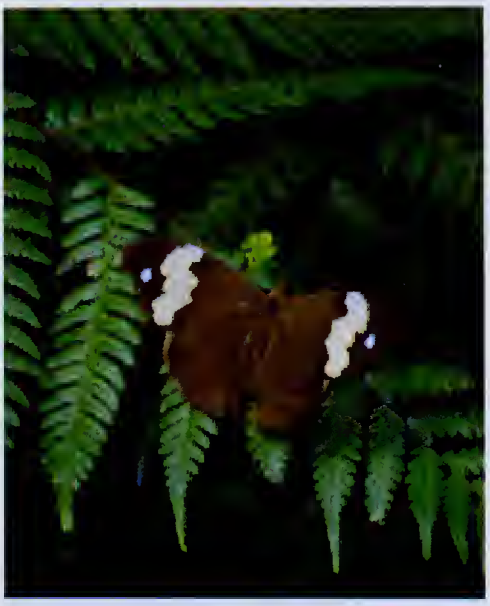

Fig. 5. Wonder Brown *Heteronympha mirifica.*

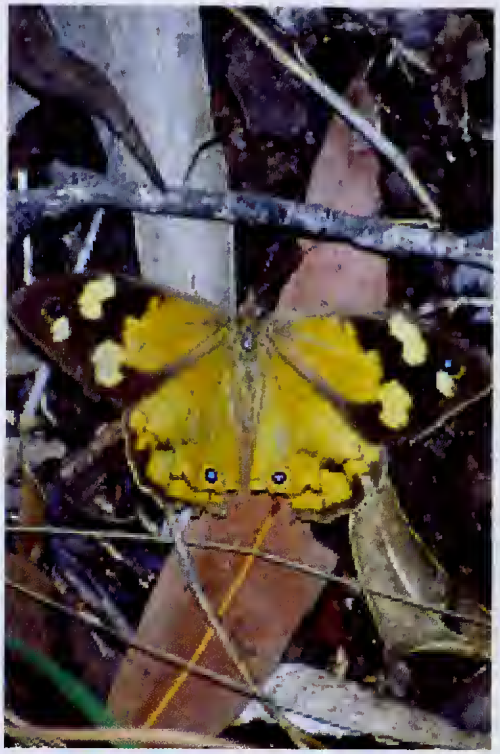

Fig. 6. Common Brown *Heteronympha merope.*

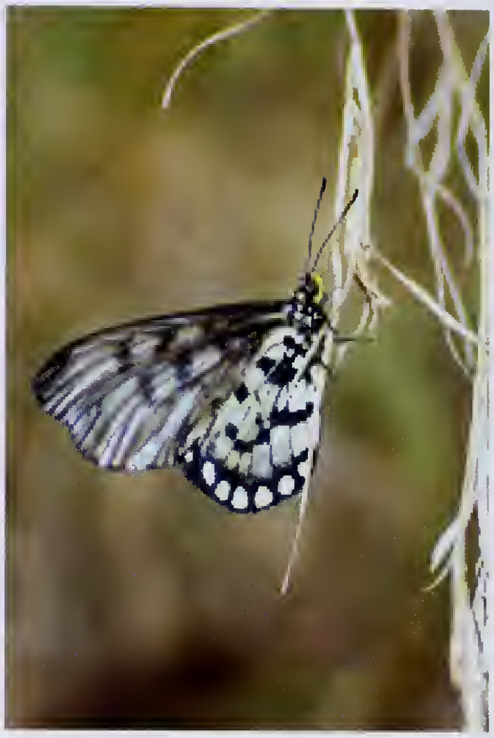

Fig. 7. Glasswing *Acraea andromacha.*

iour (including congregating, patrolling and chasing) by a number of species including the Bronze Flat, Fourbar Swordtail, Blue Triangle, Black Jezebel, Tailed Emperor and Glasswing was observed there. The total number of species and number of hill-topping species recorded at Korora Lookout is within the range of that documented at other butterfly hill-topping sites between Sydney and the NSW/Queensland border (Newland 1997; Dunn 2006; Hawkeswood 2007; Britton and Ginn 2008).

For a survey of the temperate butterfly fauna of north-western Sydney, Britton and Ginn (2008) estimated that three to four visits could suffice for an experienced lepidopterist to identify over 90% of the butterfly species occurring at a given hill-top site. They further recommended that survey timing include both January-March and October to capture seasonal variation. The cumulative curve for species recorded at Korora Lookout during 8 visits over the period January-April and October 2004 (with butterflies a primary target for observation) shows that only 59% of total species known for the site had been identified by the fourth visit and that 90% was only reached at the seventh visit (Fig. 8). The two additional species only recorded outside this period were the Common Brown (in March 2002) and Varied Sword-grass Brown (in May 2004). The slower detection rate at Korora Lookout may reflect the relative inexperience of this author (a general zoologist rather than butterfly specialist) or could be related to this particular site. As noted above, skippers (Hesperiidae) and blues (Lycaenidae) were poorly sampled in the present study, and it is likely that further survey including targeting of these groups would identify additional hill-topping species at Korora Lookout.

Bruxner Park Flora Reserve is significant as one of the few surviving lowland rainforest sites on the NSW north coast (Date *et al.* 1991) and supports a very rich land snail fauna (Murphy 2007) and vertebrate fauna (Murphy and

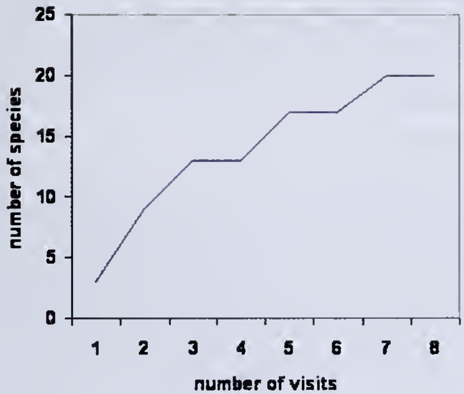

Fig. 8. Cumulative species curve for detection of butterfly species at Korora Lookout, Bruxner Park Flora Reserve, over the period January-April (6 visits) and October (2 visits) 2004.

Murphy in press). The present paper highlights the diverse butterfly fauna of the reserve, typical of the NSW north coast. Degradation and loss of hill-topping sites is a significant threat to butterflies (NSW Scientific Committee 2001; Sands and New 2002; Hawkeswood 2007) and the butterfly hill-topping site at Korora Lookout reported here is an addition to the documented conservation values of this small reserve.

Acknowledgements

My children Sam, Jess and Nicola helped with field observations. Dave Britton provided Australian Museum records from the Coffs Harbour area and advice on grass-dart identification, and an anonymous referee made helpful comments on the draft paper. All photographed animals are from Bruxner Park.

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Received 6 May 2010; accepted 11 November 2010

The Tasmanian records of the Swamp Helmet-orchid *Corybas fordhamii* (Rupp) Rupp

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Abstract

The Swamp Helmet-orchid *Corybas fordhamii* (Rupp) Rupp was collected in a southern gully of the Darling Range on Flinders Island in September 1972 when about 45 plants were noted. The species had not been recorded in Tasmania previously. It was found again in early May 2005 when just two leaves were noticed, although 142 plants were found when the site was visited in late August and early September of the same year. The gully was visited five times in September 2009 when 102 orchids were found. Most plants were upstream or downstream of the localities of 2005. The vegetation of the all sites is described below but the exact locality is not given as the orchid is scheduled as endangered under the Tasmanian *Threatened Species Protection Act 1995*. The records, and two potential threats, are discussed. (*The Victorian Naturalist* **128**(1) 2011, 18-22).

Keywords: Flinders Island, Swamp Helmet-orchid, *Corybas fordhamii,* endangered Tasmanian plant.

The discovery in 1972

In July 1972, Maureen Christie and the author collected several plant specimens, including the Veined Sun-orchid *Thelymitra cyanea*, in a southern gully of the Darling Range on Flinders Island. No field notes were taken and the only written record of the ramble is the plant-press slips for the specimens. Two include rough sketch maps showing the gully. The author revisited the site two months later, probably because puzzling orchid leaves had been noticed in the unusual, very wet habitat.

The site's main cover in September 1972 was Scented Paperbark *Melaleuca squarrosa* from 60 cm to 1.5 m high. There were also occasional Dagger Needlewood *Hakea teretifolia* to 1.8 m and Manuka *Leptospermum scoparium* of 1.2 to 1.8 m. These three shrubs gave about 60% cover. The shorter shrubs were the Blunt-leaved Heath *Epacris obtusifolia*, Pink Swamp-heath *Sprengelia incarnata* and a Guinea-flower *Hibbertia* sp. The notes do not mention how common they were. Three of the herbs were on very damp ground. They were the Forked Sundew *Drosera binata,* a Greenhood orchid (probably *Pterosylis uliginosa*) and, in 'deeper parts', the Square Twig-rush *Baumea tetragona.* The 11 other herbs included the Short Purple-flag *Patersonia fragilis*, Slender Twine-rush *Leptocarpus tenax,* Tall Yellow-eye *Xyris operculata* and Large Tongue-orchid *Cryptostylis subulata.* Some '40 or 50 plants' of a novel Helmet-orchid were found and the species was identified, using Nicholls (1969), as the Swamp Helmet-orchid *Corybas fordhamii* (Rupp) Rupp. This orchid had not been recorded previously in Tasmania and the seven collected plants are the first Tasmanian specimen. The notes give no indication of the size of the site nor how far it was from either bank.

Specimen: 14.ix.1972. The sopping bed of a seasonal stream of the slope at the southern end of the Darling Range, Flinders Island. John Whinray C2 052, Australian National Herbarium, CANB 332393.

The records of 2005

Much of the southern side of the range was searched in 2005 and two plants of the Swamp Helmet-orchid were chanced on at the western edge of the main eastern runnel on 2 May. The reason for a search of five days was that the sketch maps were not precise and the dominant vegetation did not match the details recorded in 1972. They indicated shrubs of a similar age, giving the impression that they had grown after a bushfire. However, the gully's old Scented Paperbarks had all tillered after a fire in January 2003 and were markedly taller than the seedling Manukas and Scented Paperbarks of 1972. While there were dead Dagger Needlewoods along the main eastern runnel, no seedlings were noticed. It is difficult to understand why a fire, fierce enough to kill the paperbarks com-

pletely, would not have seriously damaged the mounds carrying orchids.

The gully was examined carefully on 20 August 2005. While the original site was not located, Swamp Helmet-orchids were found where the bed — about 20 m wide — consisted of low mounds, most of which carried at least one Scented Paperbark. The main eastern runnel divides into five or more after heavy rain. While thousands of short seedlings of the paperbark were present, the dominant layer — up to 2 m high — was formed by tillers of the older shrubs which were about 6.6 m high when burnt in January 2003. All the Swamp Helmet-orchids were found on mounds crowned by Scented Paperbarks. One mound, which rose about 20 cm above the sopping soil, carried Spreading Rope-rush *Empodisma minus,* Hairy Rice-grass *Tetrarrhena distichophylla,* Pink Swamp-heath *Sprengelia incarnata,* Umbrella Fern *Gleichenia microphylla* and seedling Manuka. Tall Cutting-rush *Lepidosperma elatius* was also listed but, as there was no trace of it in 2009, the record must be based on the mis-determination of an immature sedge or lily. The Helmet-orchids rose from a mat of delicate liverworts, mainly a *Riccardia* sp. The only extra associated plant of the other mounds was the Large Tongue-orchid. Seventy-four Swamp Helmet-orchids were listed during this search, and the highest number recorded for one mound was ten. The second Tasmanian specimen was collected.

The third specimen was obtained from another mound on 3 September 2005 where the tillering shoots of the Scented Paperbark had reached 1.2 m high. The collection was taken 10–15 cm above water-level. Hairy Rice-grass was the main low cover. Also present were Spreading Rope-rush, Slender Twine-rush, Swamp Selaginella *Selaginella uliginosa,* Wiry Bauera *Bauera rubioides*, Swamp Boronia *Boronia parviflora*, Square Twig-rush and the matting liverworts. The only extra herb noticed with the orchids during this visit was the Ivy-leaved Violet *Viola hederacea*. Sixty-eight more Swamp Helmet-orchids were listed, bringing the total to 142. The highest number found on one mound during this visit was 34 plants. So two mounds carried 44 plants, just under a third of the total. The two patches of plants occupied about 30% of a rectangle that was estimated at about 19 m by 16 m. The main occurrence was along the eastern runnels. The minor one extended to the west from beside its southern part, occupying the edge of the dense Scented Paperbark where it gave way to the more open, sedgy ground. The area was checked to the base of the western bank. The Scented Paperbark was more dense in one part near the bank, and the crowns of the mounds were burnt shallowly by the fire of January 2003, probably because they were drier than the eastern ones. The lower cover of the burnt ground was predominantly, and often only, the foliose liverwort *Marchantia berteroana.*

Specimens: 20.viii.2005, Flinders Island. Near the locality of the specimen of 14.ix.1972. John Whinray 12551, National Herbarium of Victoria MEL 2331214.
3.ix.2005, Flinders Island. Near the locality of the prior specimen. John Whinray 12567, CANB 784197.

The searches in 2009

The gully was visited five times between 10 and 20 September 2009. The four sites recorded by GPS in 2005 were located eventually but there was no trace of any of the orchids listed at or near them. Only 17 Swamp Helmet-orchids were found in the two adjoining sites where 142 plants were listed in 2005. The dominant vegetation of the eastern runnels at the time of the fire of January 2003 was Dagger Needlewood and Scented Paperbark. While many of the latter had tillered, reaching up to 3.6 m, no sapling Needlewoods were noticed. The runnels ran up to 30 cm higher during the recent heavy rains and their banks were largely clear of fallen paperbark leaves. Further to the west, where paperbarks were the sole dominant, their leaves formed layers to several centimetres thick, suppressing most — and often all — of the small herbs. Spreading Rope-rush (to 2.4 m) was their main understorey species and Square Twig-rush (to 1.65 m) the minor one.

A site where a minor runnel left the western side of the main eastern one had a main cover of Dagger Needlewood (to about 3.6 m high) in January 2003. There were three Helmet-orchids on this mound. Its vegetation varied but the crown, with one of the orchids, carried Scented Paperbark seedlings to 30 cm high (c.

5% cover). The main lower cover was Spreading Rope-rush (c. 30% cover) browsed short by wombats. There were also small amounts of Swamp Selaginella and an immature sedge. The two Large Tongue-orchids had tiny leaves and there was one Angled Lobelia *Lobelia anceps*. The Salt Pratia *Pratia irrigua* was the only extra herb found with the other plants of this area.

Thirty-three of the current plants were found along the eastern runnels to about 30 m north from the northern end of the main occurrence of 2005. All the mounds in an open area had been browsed heavily by wombats and many showed evidence of flowing water around them. One large mound was 2 m east of the edge of the Scented Paperbarks. It had water running on one side and trickling past the other. The Scented Paperbark seedlings were from 10 to 20 cm high (c. 20% cover), but its main cover was Spreading Rope-rush (c. 60% cover) nibbled short. Slender Bog-rush *Schoenus lepidosperma* occurred throughout. There were also very minor amounts of the ground lichen *Cladia aggregata*, Hairy Rice-grass, Tall Tongue-orchid, Swamp Selaginella, a Yellow-eye *Xyris* sp., Creeping Raspwort *Gonocarpus micranthus* and Tiny Sundew *Drosera pygmaea*. The three Helmet-orchids were in the more open parts of the mound and one of them was flowering. Its large leaf was 16 mm long and the flower stood 14 mm high.

Only seven Swamp Helmet-orchids persisted at the southern site of 2005. Four plants, with leaves from 6 to 12 mm long, were on the browsed slope of a Scented Paperbark mound. The paperbark seedlings were to 30 cm (c. 5% cover), and there was one Manuka seedling. Spreading Rope-rush formed about 20% cover. The balance of the short, open cover was Swamp Boronia, Wiry Bauera, Pink Swamp-heath, Swamp Selaginella, Yellow-eye, Hairy Rice-grass and barren fronds of the Screw Fern *Lindsaea linearis*.

Five scattered occurrences, totalling 31 plants, were found for about 80 m downstream of the 2005 sites. They were usually where the Scented Paperbarks and Dagger Needlewoods were sparse before the fire of January 2003. There was no trace of the orchid where the paperbarks grew densely on slightly higher ground. The latter carried a thick layer of fallen paperbark leaves except where wombats had scratched the surface down as much as 30 cm. The major site was in a gap in the locally dominant Scented Paperbarks. There were 16 Helmet-orchids in an area of 40 cm x 15 cm on a mound. Cropped seedling Manuka, Scented Paperbark and Pink Swamp-heath gave just 5% cover. Also present were Spreading Rope-rush, Hairy Rice-grass, Swamp Selaginella, Square Twig-rush and three species of liverworts. Austral Leek-orchid *Prasophyllum australe*, Forked Sundew *Drosera binata*, and Blunt-leaved Heath *Epacris obtusifolia* were seen in this area for the first time.

The eastern runnels carry water from the slope to their north. While the chart shows the main gully as running through the area dealt with above (Tasmap 1998), only about a tenth of the upstream flow actually reaches it. It seems mostly to seep and trickle down the slope to the south. A runnel appears under paperbarks about 60 m north north west of the main orchid area, flowing from yabby holes. Twelve of the 21 Swamp Helmet-orchids of this isolated area were noticed at the edges of the runnel's first 8 m, cleared of fallen paperbark leaves by the recent rains. The species peters on one of the heavily browsed mounds of open ground just south of the paperbarks. The mound rose about 30 cm above the water flowing along its western and southern sides. The Slender Twine-rush (c. 15% cover) and Spreading Rope-rush (c. 70% cover) were nibbled short. Swamp Selaginella (c. 15% cover) and Hairy Rice-grass formed their understorey above the five Helmet-orchids. There was no main runnel for about 30 m downstream from this site and reaching that far south required some crawling. In this section runnels flowed from yabby holes, divided, disappeared briefly into others, re-emerged, and, in parts, no surface water ran. All the runnels have low banks that probably become too dry as none carried any orchids.

Further possible habitat on Flinders Island

Two very wet Scented Paperbark gullies can be seen further north from high in the Darling Range. One drains the north-eastern slopes of Mount Counsel; the other rises on the south-western side of Mount Leventhorpe. The total length of their sections, which flow in at least three runnels after heavy rain, is about a kilometre. It would be a major task for one person

to examine them thoroughly, criss-crossing from side to side. The most practicable way would be to have a party form a line across the bed and then work slowly upstream. As the smallest Swamp Helmet-orchid leaves in 2009 were just 3 and 4 mm long, and the largest 16 mm, the task would be painstaking. To judge by the inspections of September 2009, such a survey would be best done during the first two or three seasons after a bushfire. Surveys after that would be likely to find plants only on naturally bare soil, especially beside the runnels, or in spots where browsing wombats have kept the sedges, and any seedling shrubs, short. Under Scented Paperbarks, their leaves would form a layer too thick for any orchids to rise through. Plants were noticed in 2009 only on sites that lacked anything more than a very sparse layer of fallen paperbark leaves.

Two threats to the orchid gully

The only weeds in 2009 were very small plants of the exotic Flat-weed or Bear's-ear *Hypochoeris radicata* and all the noticed ones were removed. Their seeds probably blew from the pasture to the west and south-west. Annual inspections should be made to forestall the dense concentrations of Spear Thistle *Cirsium vulgare* which can be found in the bush many kilometres from the pasture on Flinders Island. Generally the Helmet-orchids occurred on wet to sopping sites close to water. Where there was no surface water, standing in the hollows between the mounds in 2005 brought some to the surface. Had the very wet, peaty soil dried out by the time of the fire of January 2003, it would have burnt fully, killing the Scented Paperbarks and all of the orchids. The main threat to the site is a narrow gully eroding slowly upstream. It has cut down about 2 m and has nearly reached the start of the broad part of the bed that carries most of the Helmet-orchids. It may be practicable to stop it from working further up the gully, lowering the water table and making the bed too dry for the Helmet-orchids.

Discussion

The site of 1972 was not identified with certainty. However, given the rough sketch maps of earlier that year, the shrubs present in 2009, and especially the occurrence then of the Swamp Greenhood, it seems likely that the original site was in the more open part of the bed not far south of the dense Swamp Paperbark area worked in 2005.

In 2009, just over six and a half years since the last bushfire, the Swamp Helmet-orchids were confined to naturally clear areas at the edges of runnels and to spots where the sedges and any seedling shrubs were being kept short by wombats. Jeanes and Backhouse (2006) noted that in Victoria helmet-orchids grow '...under dense thickets of Scented Paperbark (*Melaleuca squarrosa*) in and around swamps and watercourses, usually on low hummocks just above the water.' They add that the orchid is 'Usually seen only when the dense shrubby vegetation has been burnt ...' Bishop (2000: 166) noted that 'Vegetation is often very thick where the species grows and it can remain unnoticed for many years until a summer bushfire reveals it ...' It seems likely that some Tasmanian plants could remain visible until the next bushfire although, if the 2009 season is typical, only a tiny proportion of them may flower.

The difficulty of working the paperbark area in 2009 made it hard to find the various spots recorded by GPS in 2005. In parts the scrub was impenetrable because of dense fallen older Swamp Paperbark boles and the thick regrowth through them. In others it was impossible to stand and attempt GPS readings. As well the level of accuracy of the GPS readings added to the difficulty of finding previously-recorded points. It could be useful—in such vegetation—to mark a couple of GPS sites soon after a bushfire by using heavily-galvanised star steel droppers. These would last for up to 20 years.

The 142 plants of 2005 contrast strongly with the 17 found at those adjacent sites in 2009 although another 33 plants were found upstream, and 31 downstream, of the sites of 2005. There was also a contrast in the numbers showing buds, flowers, closed flowers or eaten ones. Just four formed on the 102 plants of 2009 while 33 were listed in 2005. Nine buds were recorded in late August of the latter year but none of the plants of early September still had buds.

When the 85 orchids recorded at novel sites in 2009 are added to those found in 2005, the total reaches 227 plants. Given the marked drop in

the numbers at the sites of 2005, the finds both upstream and downstream are likely to be lower than in the several years after the fire of 2003. The Helmet-orchids occurred, with breaks, in some 170 m of the gully. In the 38 years since the discovery, the orchid has not yet been found elsewhere in Tasmania. It is scheduled under the Tasmanian *Threatened Species Protection Act 1995* as endangered. This would remain the appropriate assessment even if the orchid were found to occur in the other two gullies of the Darling Range mentioned above.

Acknowledgements
The generous loan of a vehicle by some members of the Loipune Co-operative made most of the visits of 2005 and 2009 possible. Jill Thurlow, of the library at MEL, forwarded various useful photocopies about the species. Jo Palmer and Catherine Gallagher, of CANB and MEL respectively, supplied the accession numbers of the three Tasmanian specimens.

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Received 18 March 2010; accepted 9 September 2010

Christiania (Chriss) McInnes
5 January 1910 – 7 September 2010

Chriss McInnes (1910-2010) was an FNCV member for more than 50 years and the wholehearted supporter of her husband Daniel Ernest McInnes (1906-1998), a longstanding FNCV stalwart. Dan made an invaluable and major contribution to the club, including filling the administrative roles of President, Treasurer, and Nature Show Co-ordinator. He was also involved in the construction of the FNCV microscope, a project for which he was awarded Honorary Membership of FNCV as early as 1964 (McInnes, 1998; Houghton, 1999). There is no doubt that Chriss was the major supporter of Dan in all these FNCV endeavours, as 'his closest friend and companion of more than 66 years'. This became absolutely necessary especially when their longstanding home in a delicatessen shop at 129 Waverley Road, East Malvern was transformed, following Dan's retirement, into a major storage facility for FNCV files, especially back issues of *The Victorian Naturalist*.

Chriss and Dan were married in December 1932 and opened the East Malvern delicatessen in January 1933. They established a life for themselves there, raising four boys and running a successful store.

Dan joined FNCV when the Microscopical Society amalgamated with the Club in 1954. In June 1959 Chriss joined as a member in her own right, at a time when her four children had become substantively independent. Chriss later explained her timing in joining the Club as follows:

> … and they used to say to me, 'why don't you go? They're old enough.' And I said, 'well, they might get on their bike and go for a ride and fall off or something and nobody cares', so I wouldn't go. (Houghton 2010: 7)

In those early days the family was also able to achieve a happy balance in their activities, for example when Dan wanted to go fossicking. Dan would drop Chriss and the boys off at Black Rock, so they could go for a swim while he headed over to Ricketts Point to 'fiddle around the rocks'.

From the start, Chriss was not as interested as Dan in microscopy, yet supported Dan's inter-

est with the hope that he would one day spend more time with her in the garden!

> I was thinking, 'What was it that Dan found ... most (interesting)?' ... He used to find little things that lived on seaweed and looked at them under the microscope. (Houghton 2010: 4)

One side benefit was that her garden gained the benefit of dead-seaweed compost a few weeks later.

On the other hand, Chriss became an active member in the Entomology and Marine Biology Groups that met for many years in the rooms of Peg and John Strong at Parliament House. During the 1960s Chriss regularly exhibited shells, insects and spiders at Group meetings and occasionally also at General Meetings from 1963 to 1988. As Nature Notes at the General Meeting in November 1965 she spoke on the enormous numbers of noctuid moths that had been washed up on a section of beach on Port Phillip Bay.

From the 1960s, the delicatessen business in East Malvern began declining, following establishment of the Chadstone Shopping Centre, so Dan brought his desk from the back bedroom down into the back of their shop, so he could concentrate on FNCV administrative issues. Over this period, Chriss was not as prominent as Dan in club administration but she was always supportive. In contrast, Chriss was conspicuous in the local lawn bowling club and was involved in a Pennant victory in 1974/75:

> Yes, I was a bit crook that year … And I was out, had an operation and I was out of playing for a while, and I was in the B Grade. When I was well enough to come back and play, I just played a bit of social for a while and then I got playing pennant again. Instead of being in the Bs, I got put in the Cs, and I thought, 'Oh, somebody else's sick and they get their spot back.' Anyhow they told me the C Grade had a chance of winning the flag for the section, and I'd probably strengthen them. That's what I was told. Anyhow, we did win the big flag. (Houghton, 2010: 19)

At about the same time, Chriss also began assisting Dan at meetings of the Hawthorn Junior Club. As she recalled (Houghton 2010: 4):

> ... I always went to the meetings and helped them put their things out that they'd brought. They were

encouraged to bring things that they'd found and tell one another.

Thus she encouraged and supported many budding young naturalists.

Excursions have always been a major FNCV activity and Chriss had significant involvement over many years in this respect, especially with the extended trips that were superbly organised by Excursion Secretary Marie Allender over the Christmas and Easter holiday periods. Many years later Chriss fondly remembered excursions to Lakes Entrance, Apollo Bay, Portland, Wilsons Promontory, Mt Buffalo, Mt Buller, the Snowy Mountains, Alice Springs, Darwin, Queensland's Lamington National Park and even to New Zealand. On all these occasions she took greatest interest in botany and entomology but also supported Dan's strong interest in geology and marine life. With the excursions to central Australia, Queensland and New Zealand, Chriss took part without her husband, even camping out in central Australia. With respect to the FNCV excursion to New Zealand Chriss reminisced how she supported Dan in his absence (Houghton 2010: 11):

> ... Dan decided he wouldn't go. And I thought, oh, if I book he might decide to go, but he didn't. And I quite enjoyed it.... (On this trip, one participant) ... lived up near Ballarat and he used to come down and talk rocks and all sorts of things to Dan. And (on this excursion) he was collecting rocks from New Zealand, where there had been a volcano and different things. And he'd say (to me), 'you better take a bit of this home, for Dan'. And I finished up with a box full of rocks. And I thought I might get knocked back at the customs, but they took my word that it was just rocks ...

From another perspective on these excursions, Chriss recalled that

> you'd have holidays that would let you shut the shop and the best part about these holidays ... I enjoyed them because you didn't have to cook meals ... (Houghton 2010: 9-10).

On an excursion to Beechworth, her interest in geology was stimulated by some gold fossicking (Houghton 2010: 8).

> I was mad on fossicking to see if I could find a bit of gold. And I sat on the edge of the water, and I got a dish to wash the sand away, see if I could find a bit of gold. Mr Swarbreck took a photo of that. Me sitting on the edge, getting all wet.

Chriss was very much a people-orientated person, interacting with many around her in a cheerful and helpful way both within the FNCV and in the Hawthorn Juniors. She was also one who would come to the fore at the Nature Shows and large social gatherings when many people were needed to assist. There was a network of older women in the FNCV from the 1950s onwards within which Chriss was very well known.

At her death, Chriss was one of the oldest FNCV members, having reached 100 years on 5 January 2010. She remained greatly interested in the club until her death despite being unable to attend meetings in her later years.

Acknowledgements

Sheila Houghton assisted with the preparation of this tribute, particularly with the provision of a list of exhibits that Chriss McInnes offered at FNCV meetings.

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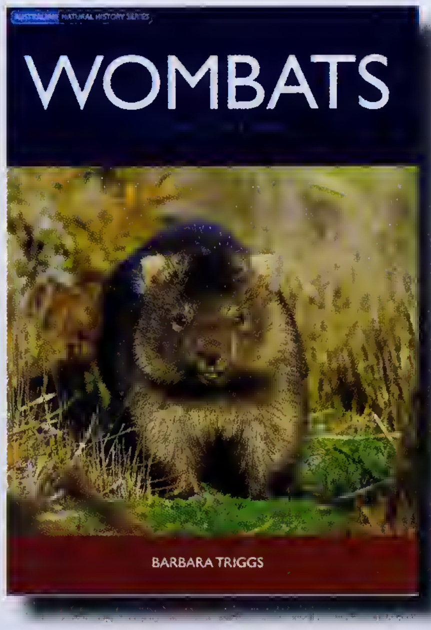
Wombats

by Barbara Triggs

Publisher: *CSIRO Publishing, Collingwood, Victoria. 2009. 153 pages. ISBN 978 0 643 09601 1. RRP $39.95*



This new edition of Barbara Triggs' delightful book on wombats in the Australian Natural History Series updates the revised first edition published in 1996. It covers the major themes as before: evolution, anatomy, behaviour, diet, growth, threats and hand-rearing. Most references are from the 1900s, with only 10 post 2000, including revised editions of two books. Nonetheless, the content and references cited will provide readers with fascinating accounts of the biology and natural history of a surprisingly poorly known group of marsupials, of which only three species are extant today.

Barbara Triggs has injected her own personal interests into the accounts of natural history, and we are the richer for it. She is an acknowledged expert in hair identification and I was thus pleased to see guard hairs of the three species described! There are also some delightful descriptions (with photos) of sleeping and grooming postures adopted and a fascinating account of schoolboy Peter Nicholson's burrow explorations, as well as the pioneering descriptive works by John McIlroy and Clive Marks. The book has also torpedoed a myth I was told in far east Gippsland by some old bushmen – wombats always defaecate in odd number lots! Triggs' photos prove this wrong!

Interestingly, Triggs prefers the term Bare-nosed Wombat to the vernacular Common Wombat:

> The name 'common wombat' is misleading; this species is no longer common and its range is declining rapidly.

Triggs notes the severe range reductions of the two hairy-nosed and the single bare-nosed species:

> The bare-nosed wombat.... Has now almost disappeared from the western half of Victoria and it is absent from all but two of the Bass Strait islands as well as from many parts of NSW where it formerly ranged. It has also declined in South Australia

Triggs blames habitat modification brought about by rabbits. The current distributions are mapped, but in relation to the above comments, a similar set of maps depicting historical ranges would be useful.

Our local Warrnambool Field Naturalists group has been discussing early records of wombats in south-west Victoria. At Deen Maar Indigenous Protected Area at Yambuck, (common) wombat burrows are still to be seen (some contain wombat bones). Samuel Hannaford wrote in 1860 about wombats being common in Warrnambool, while an early newspaper report described wombat diggings causing instability of a main street verandah! It is unknown when wombats disappeared from south-west Victoria. This illustrates how quickly common species can face local extirpation. Indeed, Triggs offers us a timely warning at the end of the book:

> It is ironic that the unique and lovable wombat, which can so easily become attached to humans, also has humans as its worst enemy. Since all three species are now protected in all states, there is probably less direct and indiscriminate kill-

ing, but land-clearing for agriculture continues to fragment the southern hairy-nosed wombat's range, and while the northern hairy-nosed wombat is now safe from humans this protection has come almost too late for that species.

The wildlife laws do not stop the bulldozers from pushing higher and higher up the slope of the Great Dividing Range or into the Tasmanian wilderness, the last bastion of the bare-nosed wombat. It is not necessary to kill the wombats directly, the destruction of their habitat will exterminate them more quickly than guns, traps or poison. The bare-nosed wombat is not an endangered species. It is not even rare, but we would do well to remember that even the most abundant species can quickly become rare or extinct if its habitat is destroyed. It is up to us to ensure that it never becomes the Uncommon wombat.

This is an excellent book which perfectly balances descriptive natural history with scientific back-up. It is beautifully written and illustrated and would make an ideal gift for anyone of any age who has a love of our Australian fauna.

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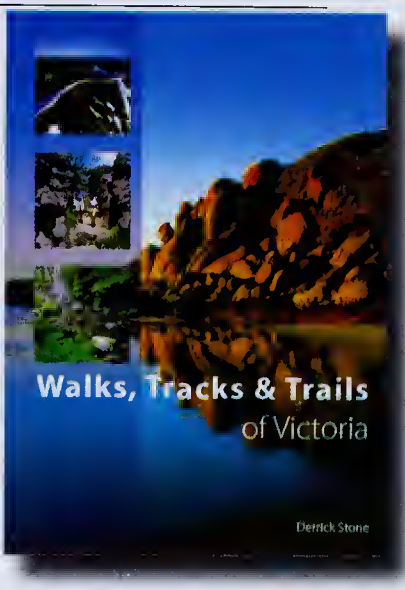
Walks, Tracks & Trails of Victoria

by Derrick Stone

Publisher: *CSIRO Publishing, Collingwood, Victoria 2009. 296 pages, paperback, colour photographs. ISBN 9780643095878. RRP $44.95.*



Derrick Stone has provided us with more than 160 of the best walks, tracks and trails in Victoria, which can be walked, cycled or driven. These are located in national and state parks, state forests, conservation reserves, historic parks and local government and public easements. Other routes follow state highways, old railways, and gold routes or pass by bushranger haunts.

The tracks and trails are arranged by geographic areas of the state, starting in the north-west and moving eastwards to conclude in Gippsland. A list at the front of the book shows the closest town, the environment of the walk, distance of each walk and the amount of estimated time necessary. Also shown is the grade of the walk from easy to hard, colour coded for easy choice according to ability. Another list arranges the walks by environment, e.g. coastal, forest, township or gold history walks.

Information provided for each track includes distance from Melbourne, how to access the walking track, the distance to be covered and grade of track, the environment and conditions to be encountered as well as recommendations on what to carry with you, e.g. water or camera, etc.

One of the best features of the book is the information included about the area in which the walk is located. Facts about the history, Aboriginal activities, flora and fauna provide fascinating background to the description of the walks, as do the photographs of the walk, features to be seen, and flora, birds and mammals. Excellent maps are included as navigational aids.

Walks, Tracks & Trails of Victoria provides something for walkers of all abilities. I can't wait to get out there and tick a few of them off.

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Planting Wetlands and Dams: A Practical Guide to Wetland Design, Construction and Propagation

by Nick Romanowski

Publisher: *Landlinks Press, Victoria 2009. 2 edn, paperback, 168 pages. ISBN 97806430096363. RRP $59.95*

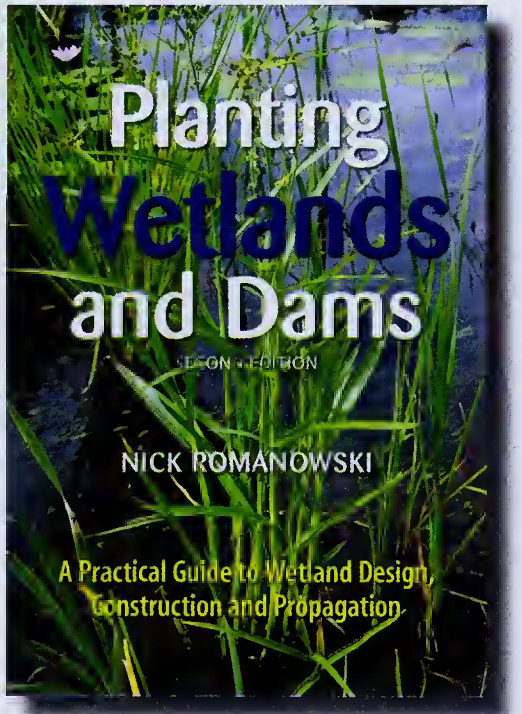
Planting Wetlands and Dams is indeed a practical guide to wetland design, construction, and plant selection and propagation. Each section of the book gives an overview of what is required for design and construction and reminds the reader of the factors that need to be considered before making decisions. Many of the wetland types, plant communities and aquatic plant species are illustrated with high quality colour plates.

The Guide begins with a description of the hydrology of a variety of wetland types, including artificial types such as constructed farm dams, and their plant communities. The importance of plants in wetlands for providing habitat, food and shelter for different animal groups is emphasised.

Before the planning of a wetland begins we are reminded that decisions about wetland design and construction must be made with a purpose in mind. Not all purposes are compatible or achievable in a single body of water, for example waterbird breeding, and provision of water for stock. Whatever the purpose of the wetland, the biodiversity can generally be enhanced by management of the hydrology to address the needs of selected species.

The Guide advocates a minimum impact approach towards construction. Site selection should follow natural contours as much as possible, with minimal earth moving to provide a balance between natural looking and inexpensive. Structures such as walkways, bird hides, fences, islands and bed profile should be used to manage people, stock and invasive species of animals and plants. Riparian vegetation and tall macrophytes can be positioned to protect the wetland against wind disturbance.

The legal requirements for constructing or restoring wetlands, as well as permits for collecting seeds and other plant material for propagation, are outlined.



In any wetland construction or rehabilitation, assessment of the water retaining capacity of the bed material is essential. Where this is found to be inadequate, other options for sealing the wetland bed are discussed, including chemical sealing, synthetic liners or importation of suitable substrates from elsewhere. The underwater landscape needs to be sculpted with shelves, plateaus and pockets of appropriate depth to support plant growth.

Plants should be selected for specific purposes and conditions rather than simply using proprietary lists of species. In existing wetlands,

the seedbank may be lying dormant but still be capable of recolonising once a suitable water regime is returned to the system. Discussion of aquatic plant dispersal concludes that estimates of how far from home wetland plants can be usefully collected should be based on the total range of any distinct form of a species.

New wetlands need to be planted with stock grown from seed or asexual propagules, transplants from other wetlands, or by direct seeding. Useful tips are provided on the collection, propagation and planting out of seedlings and other propagules. Control of pests to the newly planted wetland, such as rabbits, carp, waterbirds and common aquatic weeds, is discussed. The final chapter is an informative summary of what is known about the propagation, biology and ecology of common genera of aquatic macrophytes used in wetland construction and rehabilitation.

I recommend this book to readers who are considering constructing a wetland. As every wetland is unique, this book will make the reader aware of the areas of investigation that need to be undertaken for particular wetland projects. This book is complemented by Romanowski's *Wetland Habitats: A Practical Guide to Restoration and Management* which outlines the considerations and trade-offs involved in managing a wetland.

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Wetland Habitats: A Practical Guide to Restoration and Management

by Nick Romanowski

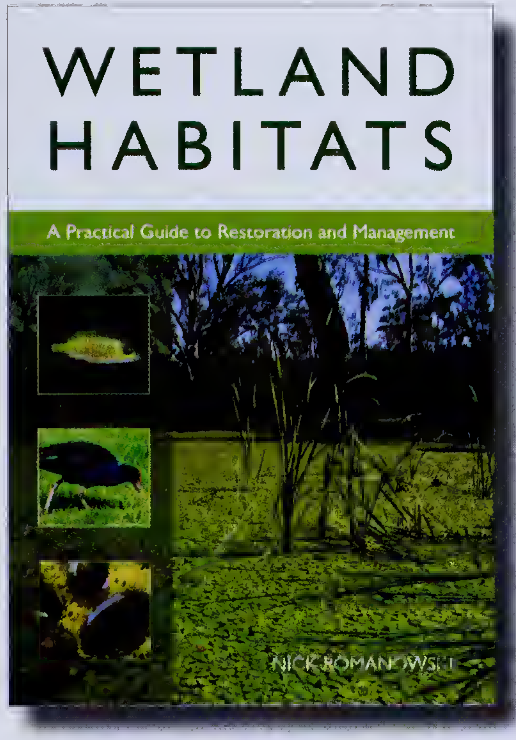
Publisher: *CSIRO Publishing, Collingwood, Victoria, 2010. 216 pages, paperback. ISBN 9780643096462. RRP $49.95*

Wetland Habitats reflects Nick Romanowski's interest and experience in the restoration and management of Australian natural and created wetlands. The book begins with a description of several types of wetland in terms of water quality and source, and the influence this has on determining the animal and plant communities that are associated with them. Many of the wetland types, impacts and threats, and key animal and plant species are illustrated with high quality colour plates.

Satisfactory habitat is not just a matter of the right water quality, shelter, food and a suitable place to breed, but is also affected by interactions with competitors and predators. Most wetland animals and many plants need more than one habitat for the long-term survival of the species. Many animal species move from one habitat to another as they mature, and their feeding or breeding requirements call for different resources.

Failings in wetland management to provide suitable habitat often stem from the fact that managers are prone to regard a wetland that looks attractive to them as one that should provide a desirable residence for the species it has been managed or created for. An attractive display of plants, the presence of water and a few species of birds are desirable parts of the wetland aesthetic; ephemeral wetlands are perceived as less desirable. Most created wetlands and dams have little habitat value for anything other than the most common and adaptable animals because their establishment did not have the specific requirements of a target species in mind.

Change over time, seasonal change, drought, flood and fire, changing salinity and physical movement of the wetland are discussed as natural components of wetland variability. Events such as flooding often trigger flowering in plants, and reproduction in fish, frogs



and waterbirds. Extreme events, such as drying out, demand that animals and plants associated with wetlands must also be able to move in response to these changes or avoid the extreme conditions in a dormant state such as seed or desiccation resistant eggs.

Major threats to wetlands are identified. Human activities involving drainage, construction of impoundments, irrigation, clearing, grazing, toxins, eutrophication, salinity, fishing, aquaculture and hunting have led to the degradation of wetlands. The introduction of weeds and alien species also poses serious threats.

The importance of background historical research and long-term monitoring in restoration is emphasised. A great deal can be achieved in terms of restoration using fairly obvious actions such as removal of drains, fencing and barriers to movement up and down stream for species such as fish. More natural timing of high flow events will trigger reproduction in plants and animals.

Weeds of disturbed areas, weeds ecologically equivalent to some natives, weeds we have to live with, floating weeds, no compromise weeds and indigenous plants as potential weeds are discussed with a view to looking at ways of dealing with them or working around them.

The background to the introduction of several species of alien animals, an overview of distribution, potential for spread and impact on natural systems is given. Broad approaches to management and control are outlined. Important questions to keep in mind are: Is the introduced species really a problem? and, What is the primary management goal for the wetland? For example, if the wetland is being managed to maintain a breeding population of long-necked turtle then swarms of introduced plague minnows may provide an abundant food source.

The last section of the book is an overview of common plants and animals found in wetlands. The habitat values of plants as food, sheltering and nesting material for animals are discussed. Different resources are provided by communities of aquatic, semi-aquatic, and terrestrial plants which occupy the open water, edge and riparian zones of a wetland. The specific resource needs of invertebrates, fish, amphibians, reptiles, birds and mammals are described.

Appendices containing an index of common and scientific names, a list of books and reports, and a glossary of terms are useful resources.

I recommend this book to readers who are looking for an overview of the factors to be considered, and the trade-offs involved in the long-term management of a wetland. This book builds on Romanowski's earlier publication *Planting Wetlands and Dams: A Practical Guide to Wetland Design, Construction and Propagation.*

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Reptiles of the NSW Murray Catchment: A Guide to Their Identification, Ecology and Conservation

by Damian Michael and David Lindenmayer

Publisher: *CSIRO Publishing, Collingwood, Victoria, 2010, 248 pages, paperback, colour photographs. ISBN 9780643098206. RRP $39.95*

Reptiles have generally fared better in Australia since European settlement than many of our native mammals, birds and amphibians. Despite this, there are many reptiles we still know very little about that are currently threatened with extinction. Although Australia has a significantly greater diversity of reptiles than most other countries, they are often overlooked or thought of as being of limited value for assessing faunal responses to habitat restoration. This may be due to a perceived lack of habitat specialisation for many species or difficulties in monitoring them. Yet recent studies suggest that some reptiles may show strong positive responses to targeted habitat restoration, something that can often easily be monitored by actively searching or using artificial shelters.

While many reptile guides provide information on topics as broad as collecting, legislation, first aid and captive husbandry, very few provide detailed information relevant to ecological restoration and management aimed at reptile conservation. *Reptiles of the NSW Murray Catchment* is likely to be the first popular Australian reptile guide to do so.

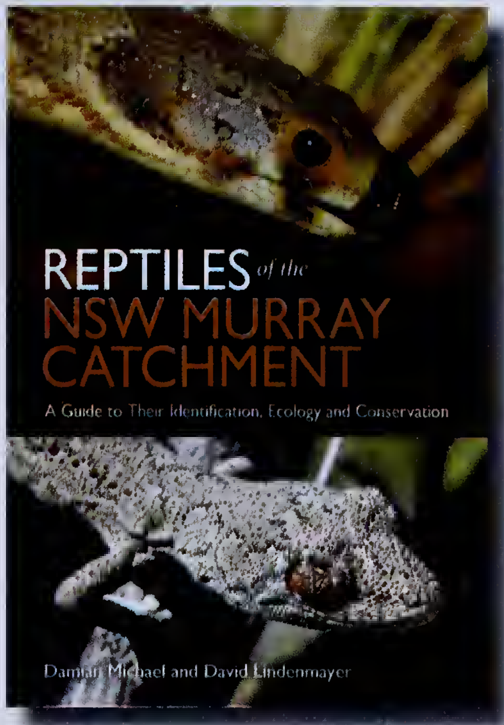
It is important to note that the scope of the book is limited to documenting the reptiles of the south-central NSW Riverina and associated slopes and, while not covering all of the reptiles of the greater Murray-Darling Basin in NSW, it does provide a fairly comprehensive overview of those species with distributions that fall within this smaller sub-region. The region itself covers a diverse range of vegetation communities, from mallee-spinifex woodlands in the west to alpine grasslands and herbfields in the east, resulting in the inclusion of reptiles from over a dozen different habitat types. Although the book is primarily targeted at landholders in the Murray Catchment, many of the basic management actions described may also be applied to other parts of the country.

As the authors acknowledge, the common names used in the book have been selected from prior publications. Some of these names are infrequently used by reptile enthusiasts or may be specific to particular regions. This is not a problem in itself; however, only common names have been used when referring to species in the chapters preceding the species descriptions, requiring constant referral to the index or appendices for readers more familiar with scientific names.

Such is the morphological variation within some reptile species, that some of the key distinguishing features mentioned in the species' descriptions are variable and may not necessarily be representative of every individual, even within the same region. This is an unavoidable reality for many reptile guides, and getting around it would probably significantly add to the length and price of a publication such as this. Although general, wherever possible, the species descriptions are intentionally based on morphological characteristics that may be seen without necessarily having to catch and examine specimens in the hand. In many cases, this avoids the need for specialist knowledge and procedures (and scientific research permits) to identify specimens.

Photographs form an important part of this guide, and most have been carefully selected to show important identifying features or reptiles engaged in interesting behaviours. For several species, more than one photograph is presented, often showing a close-up of the head or other important feature as well as a whole-body shot.

Up-to-date distribution maps for each species include the locations of watercourses and ma-



jor towns in the Murray Catchment, although the locations of some natural and man-made features referred to in the text, such as national parks and major roads, are not shown.

The final chapter deals with the identification of skinks of similar appearance, neatly summarising key identifying features into tables for each genus or group of similar-looking skinks. This provides a quick and easy guide for initial identification, then directing the reader to the species description for more definitive confirmation.

Reptiles of the NSW Murray Catchment draws on a significant amount of detailed local knowledge as well as the broader scientific literature, and although there are a few grammatical errors in places, the text is generally well written and likely to be easily understood by beginning herpetologists as well as land managers and professional ecologists.

David Lindenmayer is a well-known and respected authority in the areas of conservation biology and forest ecology, and this book is a very welcome addition to his ever-growing list of popular publications. For Damian Michael, it offers a wonderful opportunity to share his extensive expertise and knowledge of the region's reptile fauna.

Both authors are to be congratulated for putting together what is overall an outstanding regional guide that will appeal not only to conscientious landholders and managers in the lower Murray Catchment, but to anyone with broad interests in the life history, identification and hands-on conservation of Australian reptiles.

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